

The Impact of Internal Audit on Improvement of Quality System According to Requirements for Performance Competence of Calibration and Testing Laboratories ISO: IEC 17025:2005 in National Leather Technology Center and Sudanese Standards and Metrology Organization, Khartoum State- Sudan

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Abstract: The study aimed to determine the impact of the internal audit on improvement of the quality system according to requirements for performance competence of calibration and testing laboratories ISO/IEC 17025:20005. The study was conducted at National Leather Technology Center (NLTC) and Sudanese Standards and Metrology Organization (SSMO) in Khartoum State- Sudan, during the period from August 2018 to August 2019. A questionnaire was used as data collection tool. Thirty questionnaires were distributed to all laboratories employees in NLTC and SSMO, 26 of the laboratory employees had respond with percentage of (87%), while 4 had not respond. The data were analyzed using the statistical package for the social sciences (SPSS); the methodology used was the descriptive correlation. The study showed that (65.9%) respondents agreed that there was a relationship between the application of internal audit methodology and the application of the quality management system according to requirements for performance competence of calibration and testing laboratories ISO/IEC 17025:2005. Also, the study indicated that (56%) respondents agreed that there was relationship between the application of internal audit methodology and number of cases of non-conformity of the quality system according to requirements for performance competence of calibration and testing laboratories ISO/IEC 17025:2005, and readiness for accreditation. Also, the study showed that (54.6%) of them agreed that there was relationship between the application of the internal audit methodology and the continuous improvement of the quality system and increase customer satisfaction. So, the study concluded that all three hypothesis were fulfilled.

Keywords— Impact; Internal audit; Improvement; ISO/ IEC 17025:2005

1. INTRODUCTION

ISO/IEC 17025 is an ideal management system model for laboratories because it aims to control quality costs, improve measurement accuracy and guarantee consistency of results. It is also customer-driven when implemented correctly. Furthermore, when your company achieves ISO/IEC 17025 accreditation, you will be presented with a certificate of accreditation. This certificate can be used in advertising, promotional literature and stationary to show current and potential customers that your laboratory is committed to quality and has demonstrated technical competency to perform calibration or testing services [1]. There are two main clauses in ISO/ IEC 17025:2005 management requirements and technical requirements. Management requirements are specializes in the operations, activities and

the effectiveness of the quality system in the laboratory. And it has requirements similar to the standard requirements of ISO 9001. Technical requirements address the competence of staff, testing, methodology, equipments and reporting of test and calibration results. In the 10th items of the standard of ISO/IEC 17025:2005 improvement was achieved as a basic requirement by improving the effectiveness of the quality system continuously by focusing on quality policy, quality objectives, internal audit results, data analysis, corrective actions, preventive actions and management review [2]. Auditing is defined as the on-site verification activity, such as inspection or examination, of a process or quality system, to ensure compliance to requirements. An audit can apply to an entire organization or might be specific to a function, process, or production step. Some audits have special administrative purposes, such as auditing documents, risk, or performance, or following up on completed

corrective actions. Some audits are named according to their purpose or scope. The scope of a department or function audit is a particular department or function. The purpose of a management audit relates to management interests, such as assessment of area performance or efficiency. An audit may also be classified as internal or external, depending on the interrelationships among participants. Internal audits are performed by employees of your organization. External audits are performed by an outside agent. Internal audits are often referred to as first-party audits, while external audits can be either second-party or third-party [3]. Internal audit is one of the most important requirements of the system of organizations that adopt ISO/IEC 17025:2005 which is one of the most important which is mediated by examines and evaluates the activities within the organization which have been established in the form of producers and work instructions to ascertain their compliance with requirements of standard 17025. Implement the producers established by them and ensure their effectiveness and seek to improve all their activities to increase their effectiveness [3]. The main objectives of this study were to identify the relationship between implementation of internal audit and improvement of the quality system according to requirements of ISO/IEC17025-2005 in the study area, to identify the relationship between implementation of internal audit and the number of cases of non-conformity of the quality system according to requirements of ISO/IEC17025-2005 and to identify the relationship between implementation of internal audit and continuous improvement of the quality system and increases of customer satisfaction according to requirements of ISO/IEC17025-2005.

2. Materials and methods

2.1 Study design:

It is descriptive study.

2.2 Study area:

The study was conducted at National Leather Technology Center (NLTC) and Sudanese Standards and Metrology Organization (SSMO), Khartoum State- Sudan.

2.3 Study population:

The study was conducted on laboratory employees at National Leather Technology Center and Sudanese Standards and Metrology Organization.

2.4 Sample size:

The targeted sample of this research was the total population of the laboratories employees (30), (15) from SSMO and (15) NLTC but the actual sample number was 26 (13 from each) who had respond to the questionnaire.

2.5 Study period:

The study was conducted during the interval from August 2018 to August 2019.

3. Methods

3.1 Data collection methods:

In general, the procedures used for collecting the data and all the needed information in this study, were the observations, that were get it from questionnaire, so, a questionnaire (appendix) was used as the basic tool. The quantitative survey consisted of questionnaire contain three hypothesis that cover the research questions which distributed for laboratories employees. The study depends on the questionnaire as a key to offer gathering information from the study population, as for questionnaire advantages including: can be applied to get information on the number of individuals, the low cost and ease of application, ease of put the questionnaire questions and the questionnaire save responder time and give him a chance to think, this effect the reliability and validity of the answers, stability means that measures give the same results if used more than once under similar conditions. Reliability is defined as the extent to which a questionnaire, test, observation or any measurement procedure produces the same results on repeated trials. Validity is defined as the extent to which the instrument measures what it purports to measure and calculate in many ways represents the easiest being the square root of the reliability coefficient. The validity was calculated according to equation as the following:

$$\text{Validity} = \sqrt{\text{Reliability}}$$

he reliability coefficient was calculated according to Spearman-Brown Equation as the following:

$$\text{Reliability Coefficient} = \frac{2 \times r}{1 + r}$$

r = Pearson correlation coefficient.

3.2 Questionnaire design:

The following five steps of questionnaire design process were followed:

Firstly, the information was determined to be drawn from the research objectives, questions and hypothesis with consideration to who will be able to supply the information. Secondly, the structure and the length of the questionnaire were determined, the questionnaire was self-administrated and thus the gave clear instructions with direct and simple questions. Thirdly a draft questionnaire was prepared considering the content, format, layout ...ect. Fourthly, the questionnaire was pre-tested and revised. Fifthly, the questionnaire reliability and validity were assessed. The questionnaire was contained two main parts, first of them concerned with the basic information of the respondents. The second part of the questionnaire comprised (19) questions distributed to the three hypotheses as follows: first hypothesis, contained (7) questions, second hypothesis, contained (7) questions and third hypothesis, contains (5) questions.

3.3 Data analysis:

The data obtained were analyzed using the Statistical Package for Social Sciences (SPSS). To achieve the objectives of the study, statistical methods were used the frequency distribution of the answers, the percentages, Person correlation coefficient, Spearman-Brown equation for calculating reliability coefficient, median and chi-square test for the significance of differences between the test results considering all other variables. Then data were presented in tables.

3.4 Ethical consideration:

Study permissions were obtained from College of Graduate Studies- Sudan University of Science and Technology, then from Management of National Leather Technology Center (NLTC) and Sudanese Standards and Metrology Organization (SSMO) to carrying out the study in their laboratories.

4. Results

The results showed that all reliability and validity coefficients for pre-test sample individuals about each questionnaire's hypothesis and for overall questionnaire were greater than (50%) and some of them were nearest to one. This indicates to the high validity and reliability of the answers, so, the study questionnaire was valid and reliable and that gave correct and acceptable statistical analysis (table 1). Out of 26 subjects, 12 (46.2%) were males while 14 (53.8%) were females (table 2). Out of 26 subjects, 2 (7.7%) were in age group of (less than 30 years), 14 (53.8%) were in age group of (30-40 years) and 10 (38.5%) were in age group of (40-50 years) (table 3). Out of 26 subjects, 6 (23.1%) had had bachelor, 2 (7.7%) had higher diploma, 13 (50.0%) had master degree and 5 (19.2%) had doctorate (table 4). Out of 26 subjects 9 (34.6%) had less than 5 years of experience, 6 (23.1%) had 5-10 years, 7 (26.9%) had 10-15 and 4 (15.4%) had more than 15 years of experience (table 5). The results showed that out of 26 study subjects, 5 (19.2%) were average for extent of training, 7 (26.9%) were good for extent of training, 10 (38.5%) were very good for extent of training and 4 (15.4%) were excellent for extent of training (table 6). Out of 26 study subjects, 8 (30.8%) were technicians, 6 (23.1%) were engineers, 2 (7.7%) were director of the department, 2 (7.7%) were head of the department and 8 (30.8%) were other (table 7). The results showed that the most frequency distribution for the respondents' answers about the questions of the first hypothesis was (22) for strongly agree for the statement (The internal audit methodology contributes to ensuring the effectiveness of the quality system) (table 8). The results showed the calculated value of the median for all respondent's answers, of the 1st question was (5), this value means that, most of the respondents' were strongly agreed with that "The internal audit methodology contributes to the identification of deficiencies in the quality system". For the 2nd question was (5), this value means that, most of the respondents were strongly agreed with that "The internal

audit methodology contributes the difficulty of applying certain points in the procedures". For the 3rd question was (4), this value means that, most of the respondents were agree with that "The internal audit methodology benefits from the view of the beneficiary of the application procedures". For the 4th question was (5), this value means that, most of the respondents were strongly agreed with that "The application of the internal audit methodology leads to easy understanding and application of procedures and work instructions". For the 5th question was (5), this value means that, most of the respondents were strongly agreed with that "The internal audit methodology contributes to increasing the efficiency of procedures and work instructions". For the 6th question was (5), this value means that, most of the respondents' are strongly agreed with that "The internal audit methodology contributes to ensuring the effectiveness of the quality system". And for the 7th question was (5), this value means that, most of the respondents were strongly agreed with that "The internal audit methodology contributes to increasing the effectiveness of the procedures and work instructions" (table 9). The calculated value of chi-square for the significance of the differences for the respondents answers in the 1st question was (19.92) which was greater than the tabulated value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that "The internal audit methodology contributes to the identification of deficiencies in the quality system". In the 2nd question was (10.69) which was greater than the tabulated value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that "The internal audit methodology contributes the difficulty of applying certain points in the procedures". In the 3rd question was (13.08) which was greater than the tabulated value of chi-square at the degree of freedom (3) and the significant value level (1%) which was (11.35), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that "The internal audit methodology benefits from the view of the beneficiary of the application procedures". In the 4th question was (14.85) which was greater than the tabulated value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that "The application of the internal audit methodology leads to easy understanding and application of procedures and work instructions". In the 5th question was (13.00) which was greater than the tabulated

value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that “The internal audit methodology contributes to increasing the efficiency of procedures and work instructions”. In the 6th question was (26.85) which was greater than the tabulated value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that “The internal audit methodology contributes to ensuring the effectiveness of the quality system”. In the 7th question was (10.69) which was greater than the tabulated value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that “The internal audit methodology contributes to increasing the effectiveness of the procedures and work instructions” (table 10). The study showed that there were 120 (65.9%) answers were strongly agreed about all questions that related to the first hypothesis, 52 (28.6%) answers were agreed on that, 7(3.8%) answers were neutrally agreed about that, while 3 (1.6%) answers were disagreed about that (table 11). The value of chi-square test for the significant differences among these answers was (195.19) which was greater than the tabulated value of chi-square at the degree of freedom (3) and the significant value level (1%) which was (11.35), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with the first hypothesis. The results showed that the first hypothesis was fulfilled. The results showed that the most frequency distribution for the respondents’ answers about the questions of the second hypothesis were (19) for strongly agree for the statement (The application of internal audit methodology leads to the reduction of errors and diffraction in the quality system) (table 12). The calculated value of the median for the respondents’ answers of the 1st question was (5), this value means that, most of the respondents were strongly agreed with that “There is a procedure for adjusting and applying the internal audit of the quality system”. For the 2nd question was (4), this value means that, most of the respondents were agreed with that “The internal audit procedure is understandable and easy to implement”. For the 3rd question was (5), this value means that, most of the respondents were strongly agreed with that “The quality manger reviews the management procedures to ensure that they comply with the requirements of the standard for the efficiency of calibration and testing laboratories IO/IEC17025:2005”. For the 4th question was (4), this value means that, most of the respondents were agreed with that

“The technical manager reviews technical procedures to ensure that they comply with requirements of standard for the efficiency of calibration and testing laboratories ISO/IEC17025:2005”. For the 5th question was (5), this value means that, most of the respondents were strongly agreed with that “The application of internal audit methodology leads to the reduction of errors and diffraction in the quality system”. For the 6th question was (5), this value means that, most of the respondents were strongly agreed with that “The application of internal audit methodology leads to the reduction of cases of non-conformity by the accreditation body”. For the 7th question was (5), this value means that, most of the respondents were strongly agreed with that “The application of the internal audit methodology contributes to the follow-up of the diffraction that may appear in the procedures and work instructions”. The calculated value of the median for the respondents’ answers about the all questions that related to the second hypothesis was (5). This value, in general, means that most of the respondents’ have strongly agreed with all what mentioned about the second hypothesis (table 13). The calculated value of chi-square for the significance of the differences for the respondents’ answers in the 1st question was (11.38) which was greater than the tabulated value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that “There is a procedure for adjusting and applying the internal audit of the quality system”. In the 2nd question was (21.38) which was greater than the tabulated value of chi-square at the degree of freedom (3) and the significant value level (1%) which was (11.35), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have agreed with that “The internal audit procedure is understandable and easy to implement”. In the 3rd question was (11.62) which was greater than the tabulated value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that “The quality manger reviews the management procedures to ensure that they comply with the requirements of the standard for the efficiency of calibration and testing laboratories IO/IEC17025:2005”. In the 4th question was (10.23) which was greater than the tabulated value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have agreed with that “The technical manager reviews technical procedures to ensure that they comply with requirements of standard for the efficiency of calibration and testing laboratories

ISO/IEC17025:2005". In the 5th question was (19.92) which was greater than the tabulated value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that "The application of internal audit methodology leads to the reduction of errors and diffraction in the quality system". In the 6th question was (14.85) which was greater than the tabulated value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that "The application of internal audit methodology leads to the reduction of cases of non-conformity by the accreditation body". In the 7th question was (10.69) which was greater than the tabulated value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that "The application of the internal audit methodology contributes to the follow-up of the diffraction that may appear in the procedures and work instructions" (table 14). The results showed that there were 102 (56.0%) were strongly agreed about all questions that related to the second hypothesis, 71 (39.0%) answers were agreed on that, 8 (4.4%) answers were neutrally agreed about that, while 1(0.5%) answer was disagreed about that (table 15). The value of chi-square test for the significant differences among these answers was (158.88) which was greater than the tabulated value of chi-square at the degree of freedom (3) and the significant value level (1%) which was (11.35), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with the second hypothesis. The results showed that the second hypothesis was fulfilled. The results showed that the most frequency distribution for the respondents' answers about the questions of the third hypothesis were (18) for strongly agree for the statement (Internal audit leads to improves performance) (table 16). The calculated value of the median for the respondents' answers of the 1st question was (4), this value means that, most of the respondents were agreed with that "Internal audit contributes to the detection of diffraction before it affects the quality operations". For the 2nd question was (5), this value means that, most of the respondents' were strongly agreed with that "Internal audit enables opportunities for continuous improvement". For the 3rd question was (4), this value means that, most of the respondents were agreed with that "Internal audit helps identify best practices". For the 4th question was (5), this value means that, most of the respondents' were strongly agreed with that "Internal audit leads to improves

performance". For the 5th question was (5), this value means that, most of the respondents' are strongly agreed with that "Internal audit contributes to focus on customer satisfaction". The calculated value of the median for the respondents' answers about the all questions that related to the third hypothesis was (4), this value, in general, means that most of the respondents' have agreed with all what mentioned about the third hypothesis (table 17). The calculated value of chi-square for the significance of the differences for the respondents' answers in the 1st question was (15.54) which was greater than the tabulated value of chi-square at the degree of freedom (3) and the significant value level (1%) which was (11.35), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that "Internal audit contributes to the detection of diffraction before it affects the quality operations". In the 2nd question was (10.69) which was greater than the tabulated value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that "Internal audit enables opportunities for continuous improvement". In the 3rd question was (10.23) which was greater than the tabulated value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have agreed with that "Internal audit helps identify best practices". In the 4th question was (17.15) which was greater than the tabulated value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that "Internal audit leads to improves performance". In the 5th question was (9.77) which was greater than the tabulated value of chi-square at the degree of freedom (2) and the significant value level (1%) which was (9.21), this indicated that, there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with that "Internal audit contributes to focus on customer satisfaction" (table 18). The results showed that there were 71 (54.6%) answers were strongly agreed about all questions that related to the third hypothesis, 51 (39.2%) answers were agreed on that, 7 (5.4%) answers were neutrally agreed about that, while 1 (0.8%) answer was strongly disagreed about that (table 19). The value of chi-square test for the significant differences among these answers was (106.68) which was greater than the tabulated value of chi-square at the degree of freedom (3) and the significant value level (1%) which was (11.35), this indicated that, there were statistically significant

differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with the third hypothesis. The results showed that the third hypothesis was fulfilled. According to the values of chi-square test, the results showed that the first hypothesis was fulfilled with first order according to the first largest value of chi-square (195.19). The second hypothesis was fulfilled with second order according to the second largest value of chi-square (158.88). Lastly, the third hypothesis is fulfilled with third order according to third largest value of chi-square (106.68) (table 20).

Table 1: The statistical reliability and validity of the pre-test sample about the study questionnaire

Hypothesis	Reliability	Validity
First	0.75	0.87
Second	0.75	0.87
Third	0.72	0.85
Overall	0.83	0.91

Table 2: Frequency of study subjects according to gender

Gender	Frequency	Percentage (%)
Males	12	46.2
Females	14	53.8
Total	26	100.0

Table 3: Frequency of study subjects according to age groups

Age groups (years)	Frequency	Percentage (%)
Less than 30	2	7.7
30-40	14	53.8
40-50	10	38.5
Total	26	100.0

Table 4: Frequency of study subjects according to academic qualification

Academic qualification	Frequency	Percentage (%)
B.Sc.	6	23.1
Higher Diploma	2	7.7
M.Sc.	13	50.0
Ph.D.	5	19.2
Total	26	100.0

Table 5: Frequency of study subjects according to the years of experience

Experience years	Frequency	Percentage (%)
Less than 5	9	34.6

5-10	6	23.1
10-15	7	26.9
More than 15	4	15.4
Total	26	100.0

Table 6: Frequency of study subjects according to the extent of your training on the standard of efficiency of the performance of calibration and testing laboratories ISO/IEC 17025:2005

The extent of your training on the standard of efficiency of the performance of calibration and testing laboratories ISO/IEC 17025:2005	Frequency	Percentage (%)
Average	5	19.2
Good	7	26.9
Very good	10	38.5
Excellent	4	15.4
Total	26	100.0

Table 7: Frequency of study subjects according to the occupation

Occupation	Frequency	Percentage (%)
Technician	8	30.8
Engineer	6	23.1
Director of the department	2	7.7
Head of the department	2	7.7
Other	8	30.8
Total	26	100.0

Table 8: The frequency distribution for the respondents' answers about the questions of the first hypothesis

No.	Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
1	The internal audit methodology contributes to the identification of deficiencies in the quality system	20	5	1	0	0
2	The internal audit methodology contributes the difficulty of applying certain points in the procedures	15	10	1	0	0
3	The internal audit methodology benefits from the view of the beneficiary of the application procedures	13	9	1	3	0
4	The application of the internal audit methodology leads to easy understanding and application of procedures and work instructions	18	7	1	0	0
5	The internal audit methodology contributes to increasing the efficiency of procedures and work instructions	17	8	1	0	0
6	The internal audit methodology contributes to ensuring the effectiveness of the quality system	22	3	1	0	0
7	The internal audit methodology contributes to increasing the effectiveness of the procedures and work instructions	15	10	1	0	0

Table 9: The median of respondents' answers about the questions of the first hypothesis

No.	Statements	Median	Result
1	The internal audit methodology contributes to the identification of deficiencies in the quality system	5	Strongly agree
2	The internal audit methodology contributes the difficulty of applying certain points in the procedures	5	Strongly agree
3	The internal audit methodology benefits from the view of the beneficiary of the application procedures	4	Agree
4	The application of the internal audit methodology leads to easy understanding and application of procedures and work instructions	5	Strongly agree
5	The internal audit methodology contributes to increasing the efficiency of procedures and work instructions	5	Strongly agree
6	The internal audit methodology contributes to ensuring the effectiveness of the quality system	5	Strongly agree
7	The internal audit methodology contributes to increasing the effectiveness of the procedures and work instructions	5	Strongly agree
	Overall	5	Strongly agree

Table 10: Chi-square test results for respondents' answers about the questions of the first hypothesis

No.	Statement	Degree of freedom	Chi-square value
1	The internal audit methodology contributes to the identification of deficiencies in the quality system	2	19.92
2	The internal audit methodology contributes the difficulty of applying certain points in the procedures	2	10.69
3	The internal audit methodology benefits from the view of the beneficiary of the application procedures	3	13.08
4	The application of the internal audit methodology leads to easy understanding and application of procedures and work instructions	2	14.85
5	The internal audit methodology contributes to increasing the efficiency of procedures and work instructions	2	13.00
6	The internal audit methodology contributes to ensuring the effectiveness of the quality system	2	26.85
7	The internal audit methodology contributes to increasing the effectiveness of the procedures and work instructions	2	10.69

Table 11: The frequency distribution for the respondents' answers about all questions of the first hypothesis

Answer	Number	Percentage (%)
Strongly agree	120	65.9
Agree	52	28.6
Neutral	7	3.8
Disagree	3	1.6
Total	182	100.0

Table 12: The frequency distribution for the respondents' answers about the questions of the second hypothesis

No.	Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
1	There is a procedure for adjusting and applying the internal audit of the quality system	16	8	2	0	0
2	The internal audit procedure is understandable and easy to implement	9	15	1	1	0
3	The quality manger reviews the management procedures to ensure that they comply with the requirements of the standard for the efficiency of calibration and testing laboratories	15	10	1	0	0

	ISO/IEC17025:2005					
4	The technical manager reviews technical procedures to ensure that they comply with requirements of standard for the efficiency of calibration and testing laboratories ISO/IEC17025:2005.	12	13	1	0	0
5	The application of internal audit methodology leads to the reduction of errors and diffraction in the quality system	19	6	1	0	0
6	The application of internal audit methodology leads to the reduction of cases of non-conformity by the accreditation body	17	8	1	0	0
7	The application of the internal audit methodology contributes to the follow-up of the diffraction that may appear in the procedures and work instructions	14	11	1	0	0

Table 13: The median of respondents' answers about the questions of the second hypothesis

No.	Statements	Median	Result
1	There is a procedure for adjusting and applying the internal audit of the quality system	5	Strongly Agree
2	The internal audit procedure is understandable and easy to implement	4	Agree
3	The quality manger reviews the management procedures to ensure that they comply with the requirements of the standard for the efficiency of calibration and testing laboratories ISO/IEC17025:2005	5	Strongly Agree
4	The technical manager reviews technical procedures to ensure that they comply with requirements of standard for the efficiency of calibration and testing laboratories ISO/IEC17025:2005	4	Agree
5	The application of internal audit methodology leads to the reduction of errors and diffraction in the quality system	5	Strongly Agreed
6	The application of internal audit methodology leads to the reduction of cases of non-conformity by the accreditation body	5	Strongly Agree
7	The application of the internal audit methodology contributes to the follow-up of the diffraction that may appear in the procedures and work instructions	5	Strongly Agree
	Overall	5	Strongly Agree

Table 14: Chi-square test results for respondents' answers about the questions of the second hypothesis

No.	Statements	Degree of freedom	Chi-square value
1	There is a procedure for adjusting and applying the internal audit of the quality system	2	11.38
2	The internal audit procedure is understandable and easy to implement	3	21.38
3	The quality manger reviews the management procedures to ensure that they comply with the requirements of the standard for the efficiency of calibration and testing laboratories ISO/IEC17025:2005	2	11.62
4	The technical manager reviews technical procedures to ensure that they comply with requirements of standard for the efficiency of calibration and testing laboratories ISO/IEC17025:2005	2	10.23
5	The application of internal audit methodology leads to the reduction of errors and diffraction in the quality system	2	19.92
6	The application of internal audit methodology leads to the reduction of cases of non-conformity by the accreditation body	2	14.85
7	The application of the internal audit methodology contributes to the follow-up of the diffraction that may appear in the procedures and work instructions	2	10.69

Table 15: The frequency distribution for the respondents' answers about all questions of the second hypothesis

Answer	Number	Percentage (%)
Strongly agree	102	56.0
Agree	71	39.0
Fair	8	4.4
Disagree	1	0.5
Total	182	100.0

Table 16: The frequency distribution for the respondents' answers about the questions of the third hypothesis

No.	Statements	Strongly Agree	Agree	Natural	Disagree	Strongly disagree
1	Internal audit contributes to the detection of diffraction before it affects the quality operations	12	11	2	0	1
2	Internal audit enables opportunities for continuous improvement	14	11	1	0	0
3	Internal audit helps identify best practices	12	13	1	0	0
4	Internal audit leads to improves performance	18	7	1	0	0
5	Internal audit contributes to focus on customer satisfaction	15	9	2	0	0

Table 17: The median of respondents' answers about the questions of the third hypothesis

No.	Statements	Median	Result
1	Internal audit contributes to the detection of diffraction before it affects the quality operations	4	Agree
2	Internal audit enables opportunities for continuous improvement	5	Strongly Agree
3	Internal audit helps identify best practices	4	Agree
4	Internal audit leads to improves performance	5	Strongly Agree
5	Internal audit contributes to focus on customer satisfaction	5	Strongly Agree
	Overall	5	Strongly Agree

Table 18: Chi-square test results for respondents' answers about the questions of the third hypothesis

No.	Statements	Degree of freedom	Chi-square value
1	Internal audit contributes to the detection of diffraction before it affects the quality operations	3	15.54
2	Internal audit enables opportunities for continuous improvement	2	10.69
3	Internal audit helps identify best practices	2	10.23
4	Internal audit leads to improves performance	2	17.15
5	Internal audit contributes to focus on customer satisfaction	2	9.77

Table 19: The frequency distribution for the respondents' answers about all questions of the third hypothesis

Answer	Number	Percentage (%)
Strongly agree	71	54.6
Agree	51	39.2
Neutral	7	5.4
Strongly disagree	1	0.8
Total	130	100.00

Table 20: Summary of chi-square test for the respondents' answers about all hypothesis

No.	Hypotheses	Chi-square value
1	There is a statistically significant relationship between the application of the internal audit methodology and the application of the quality system according to the requirements of the standard for the efficiency of the performance of the calibration and testing laboratories ISO/IEC 17025:2005	195.19
2	There is a statistically significant relationship between the application of the internal audit methodology and the number of cases of non-conformity of the quality system according to the requirements of the standard for the efficiency of performance of the calibration and testing laboratories ISO/IEC17025:2005, and readiness for accreditation	158.88
3	There is a statistically significant relationship between the application of the internal audit methodology and the continuous improvement of the quality system and increases of customer satisfaction	106.68

5. Discussion

From the results, it was obvious that the most frequency distribution for the respondents' answers about the questions of the first hypothesis was (22) for strongly agree for the statement (The internal audit methodology contributes to ensuring the effectiveness of the quality system). Also, the present study showed that the calculated value of the median for the respondents' answers about the all questions that related to the first hypothesis was (5). This value, in general, means that most of the respondents' have strongly agreed with all what mentioned about the first hypothesis. From the results, the first hypothesis was achieved for each question that related to this hypothesis and there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with the first hypothesis, so, the first hypothesis was fulfilled. The results showed that the most frequency distribution for the respondents' answers about the questions of the second hypothesis were (19) for strongly agree for the statement (The application of internal audit methodology leads to the reduction of errors and diffraction in the quality system). The calculated value of the median for the respondents' answers about the all questions that related to the second hypothesis was (5). This value, in general, means that most of the respondents' have strongly agreed with all what mentioned about the second hypothesis. The results showed that the second hypothesis was achieved for each question that related to this hypothesis and there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with the second

hypothesis, so, the second hypothesis was fulfilled. The results showed that the most frequency distribution for the respondents' answers about the questions of the third hypothesis were (18) for strongly agree for the statement (Internal audit leads to improves performance). The calculated value of the median for the respondents' answers about the all questions that related to the third hypothesis was (4). This value, in general, means that most of the respondents' have agreed with all what mentioned about the third hypothesis. The results showed that the third hypothesis was achieved for each question that related to this hypothesis and there were statistically significant differences at the level (1%) among the answers of the respondents, which support the respondents who have strongly agreed with the third hypothesis, so, the third hypothesis was fulfilled. The findings from the present study were in disagreement with findings obtained by Fadul (2014) [4] who found that the services provided by national public health laboratory (NPHL) was low quality; there was no clear management system with unknown responsibilities inside NPHL, but the findings of the present study were in agreement with findings of Hamza (2015) [5] who found that the awareness and perception of top managers of ISO helped them in the process of evaluation and measuring the system as well achieving intended results, work environment inside the laboratory was suitable and helped in correct testing results and provided implementing ISO system enhanced the performance and the quality of the laboratory. Also, the results obtained from the present study were in agreement of results obtained by Mohamed (2016) [6] who found that the

effect of the ISO 17025 was clearly visible; the systems have been improved to the best.

6. Conclusion

The study concluded that there was a statistically significant relationship between implementation of internal audit and implementation of the quality system according to requirements of ISO/IEC17025:2005 in the study area. Also, there was a statistically significant relationship between implementation of internal audit and the number of cases of non-conformity of the quality system according to requirements of ISO/IEC17025:2005. In addition, there was a statistically significant relationship between implementation of internal audit and continuous improvement of the quality system and increases of customer satisfaction according to requirements of ISO/IEC17025:2005.

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